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Analysis of Nitrogen balances and Nitrogen Use Efficiency on farm level of the German agricultural sector – implications for policy design

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Nitrogen (N) use is a key environmental issue in agriculture, as losses of reactive N compounds threaten biodiversity, climate, and human health (Sutton & Bleeker 2013). The utilization of N as an essential macronutrient must become more efficient in order to mitigate the negative externalities of food production and to achieve the ambitious (inter-)national climate, environmental and sustainability goals concurrently. The Nitrogen Use Efficiency (NUE) in an appropriate indicator for assessing N utilization in farm systems, and can be estimated from the same parameters as the N balance. Thus, the aim of the present work is to quantify the level of NUE for different farm types in Germany and to identify determinants of on-farm N indicators. For that, we use data of the German Farm Accountancy Data Network (FADN), covering around 6,000 farms with comprehensive annual information on farm structure and yields, and representing the German agricultural sector. For calculating the NUE on farm level for six farm types according to EU farm typology, the relevant input and output parameters as three-years mean are considered based on Löw et al. (2021) and national legislation. Further, two explanatory models are developed to identify linkages between the N indicators investigated and farm structural (e.g., farm type, farm size, and fertilization intensity), regional (e.g., soil fertility, altitude, and soil-climate-areas), and socio-economic (e.g., age, operating profit, and education level) attributes. The MM-estimator, a robust regression technique, is utilized in order to consider the existence of outliers. First results show a sectoral NUE around 60%, with significant differences among and within farm types. The mean NUE increases from dairy, over pig and poultry, towards arable farms. Also, all farm types with animal husbandry miss the goal of a 60% farm-NUE, a level required for meeting the national Sustainable Development Goal by 2030. The explanatory models show significant results for various independent variables, such as farm size, soil fertility, or education level. However, limitations regarding organic fertilizer imports need to be considered. In order to achieve the ambitious (inter-)national sustainability goals, further efforts are needed, and efficiency reserves of all farm types must be identified and mobilized henceforward. For designing agri-environmental policies to improve N management, the NUE can serve as a robust and informative performance indicator whose relevance will further enhance due to the addressing and focusing on resource efficiency in current political and societal visions.

References

Löw, P., Osterburg, B., Klages, S., 2021. Comparison of regulatory approaches for determining application limits for nitrogen fertilizer use in Germany. Environmental Research Letters 16 (5), 55009.

Sutton, M.A., Bleeker, A., 2013. Environmental science: the shape of nitrogen to come. Nature 494, 435-437.